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A User's Manual for ADAM
(Air Force Dispersion Assessment Model)

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The Air Force Dispersion Assessment Model (ADAM) (described in Volume I of this report) is implemented in FORTRAN in a computer program. This Volume describes what computers the program will run on, how to install the program on the computer, and how to use the model. Figures and Tables are used to illustrate the computer program operation.

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ADAM SETUP PROGRAM

ADAM is currently configured to run on an IBM compatible computer which has either an Enhanced Graphics Adapter (EGA) and Enhanced Color Display or a Color Graphics Adapter (CGA) card and Color Display. A simple program must be run the first time you use ADAM to set up a file with information on the type of graphics card/display you have.

First, install ADAM on your hard disk as described in steps 1 to 5 of this Manual.

Then, run this program by typing SETUP and pressing ENTER. The screen shown below (Figure A) will appear. Simply type an E or a C, depending on the type of card/display you have and press the enter key. The program will create a new DEVICE.DAT file which contains information needed to display graphics on your monitor. You are now set up to run ADAM, as described by instructions 6 to 23 in this manual.

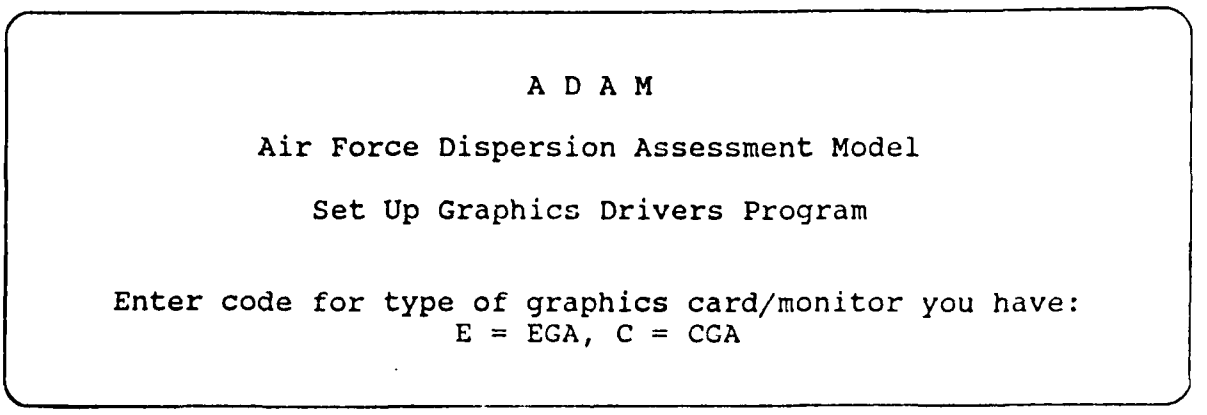

FIGURE A. ADAM SETUP Program Display Screen

1.0 INTRODUCTION

The models described in detail in Volume I of this report have been incorporated into one easy to use computer program called ADAM (Air Force Dispersion Assessment Model). The models are coded in the computer program in FORTRAN; the graphics output is coded in FORTRAN with FORTRAN compatible HALO* graphics macros for screen graphics. The complete program is designed to run on the Air Force's Zenith microcomputer. The model runs in under five minutes.

2.0 HARDWARE REQUIREMENTS

The hardware required to run this program is an IBM Compatible PC with at least 512 Kbytes of RAM (AT preferred), an EGA Color Card, an EGA Color Monitor, and a hard disk drive ("C:") with at least 10 MB capacity. The screen graphic output can be printed with a graphics printer, such as the IBM Proprinter.

3.0 HOW TO RUN THE COMPUTER PROGRAM

The program has been written to facilitate evaluation of a number of vapor dispersion scenarios with minimal effort. All input data for test cases are stored in a file. It is simple to change the input data to execute different release/spill situations or chemicals. This is achieved by modifying, in the data file, the values of only those parameters that represent a new test case. In addition, the default data may be set by the user to the most common input data used for quick entry of similar cases.

The program prompts the user to enter a "Y" or "N" in many cases to choose which option to perform. Both upper case and lower case letters are acceptable for response. The default response is assumed to be "N"; any response besides a "Y" or "y" will be considered to be an "N".

The steps for running the program are:

A. Load the program into the computer

1. Turn on the computer, as you usually do, and wait until the DOS prompt (">")appears.

2. Create a directory on your hard disk where you would like the program to reside (e.g., c:>md ADAM).

3. Insert the diskette provided with this manual into your 1.2 MB drive. If the program is provided on 360 KB diskettes (three diskettes) insert each diskette in the proper sequence in the appropriate disk drive and perform step 4.

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* HALO is a trademark of Media Cybernetics, Inc.

4. Copy the files from the diskette to the hard disk. (Copy a:*.* c:\ADAM*.*).

5. Check to make sure all files needed are present by requesting a directory listing and comparing it to the directory list in Table 1 of this manual.

B. Load your own text editor (Optional)

The program uses a text editor for the user to make changes to the input data. The software provided comes with a publicly available ASCII & text editor called ED.EXE (PC-Write, Version 2.55, 1985) developed by Quicksoft, Inc. A brief list of commands for PC-WRITE is included under step 11.

The user can, however, use his/her own editor for this task. If, an alternate editor is to be used, please perform the following steps:

6. Delete the Shareware PC-Write program from the ADAM directory (Erase c:\ADAM\ed.exe).

7. Put a copy of your editor in the ADAM directory or execute the DOS path command with the appropriate parameter (Copy c:\(your editor) c:\ADAM\(your editor) OR PATH C:\(your editor's directory\). You MUST NAME the executable file of your editor on the ADAM directory as ED.EXE. Your editor must use the following command to edit a text or data file.

ED filename.ext

C. Run the ADAM Program

8. Type ADAM at the DOS prompt and press ENTER. This will start the program execution.

9. A screen, as shown in Figure 1 should appear. This presents general information about the models. If the panel does not appear, there is most likely a file missing and an appropriate error message should appear on the screen.

10. After pressing the ENTER key, the screen shown in Figure 2 is presented on the screen. The user is asked to choose which input data the program should use. Three options are possible:

    a) If "I" is entered, the program uses the data in the current INPUT.DAT file.

    b) If "D" is entered, the program copies the default data from the DEFAULT.DAT file to INPUT.DAT destroying the current INPUT.DAT file.

c) If "U" is chosen, the program prompts the user to enter the name of the input data file to use. The program then copies the user input file to INPUT.DAT, destroying the current INPUT.DAT file.

If there is no INPUT.DAT file for any reason, the program copies the DEFAULT.DAT file to the INPUT.DAT file if "I" or "D" are entered.

11. Once the file is chosen, the command: "ED INPUT.DAT" is executed by the program. This runs the edit program and puts the user in the position to edit the INPUT.DAT file. If the editor that was included on the original diskette is used, the screen shown in Figure 3 should appear. Press the F1 key to make a back-up copy, or just <ESC> to edit the file. (Skip the next section if you are familiar with PC-WRITE Editor commands.)

PC-WRITE Editor Commands

To use the editor for the purposes of editing the INPUT data file for ADAM, only a few commands are needed. They are:

1) When the editor is first entered (See Figure 3), you must either press the esc key to immediately edit the file, or press the F1 key to make a backup copy of the file and then edit the file. The backup is stored as INPUT.&DA for the INPUT.DAT file.

2) Once you have entered the file, press the SCROLL LOCK key to avoid altering the field structure of the file.

3) Use the arrow keys to move around the file. Alternatively, the PgUp and PgDn keys can be used to move up or down one line. If the Shift key and either the PgUp or PgDn key are pressed simultaneously, the file will be shifted up or down one full page at a time.

4) Once you are done editing the file, press F1 the F3 to save the data. Then press F1 and F2 to exit the file. The calculations will resume automatically.

There is limited on-line help available if you press the F1 key. This will show you what options you have in the editor. Pressing the F1 key again returns you to editing the file.

---

12. Enter the data for the case you wish to run in the appropriate fields in the file. There are nine (9) sections in the INPUT.DAT file, as described below. For each section, the fields that must be completed, their type, length and default values are given in Table 2.

DETAILS OF INPUT.DAT FILE SECTIONS

This INPUT.DAT file contains several sections of input data. Each section asks for a different type of input information. The various sections in this file are indicated below.

File Header

This section contains rules that should be followed when editing the data.

SECTION 1: Release Information
SECTION 2: Type of Release and Source Specifications
SECTION 3: Instantaneous Release
SECTION 4: Continuous Release
SECTION 5: Ground Conditions
SECTION 6: Atmospheric Conditions
SECTION 7: Time and Location Information
SECTION 8: Output Specifications
SECTION 9: Source Specifications

Table 2 shows the print out of the DEFAULT.DAT file. Note that all real numbers are to be input in the G11.3 format. Most of the integer data (for setting up "YES" or "NO" flags) are to be input in I1 format. However, the fields for date, month and year are to be input in I2 format.

---

13. Save the file and exit the editor (for PC-Write press F1, F2, F1, F3 in sequence). This causes the source calculations to proceed. The status of the calculations is indicated in the lower left corner of the screen, as shown in Figure 4.

14. The results of the source and atmospheric stability calculations are displayed on the screen, as shown in Figure 5. The user is asked whether he/she would like to save the source calculation results in SECTION 9 of the current INPUT.DAT file. The user should input "Y" to save the information in the file. This is useful if the user wants to re-edit the input data before proceeding with the dispersion calculations.

15. The user is then asked whether he/she would like to re-edit the input data (Figure 5). If the intermediate source results are not what was wanted, the user enters a "Y" and is returned to Step 10 above. If "N" is entered, the dispersion calculations are started.

D. Dispersion Calculations

16. The program automatically begins the dispersion calculations once an "N" is entered for Step 15 above. The status of the calculations is shown in the lower left corner of the screen, similar to that shown in Figure 4.

17. Once the calculations are complete, the results are written to files and displayed graphically and with text on the screen. (The screen display is shown in Figure 6.) The user may print this screen on a graphics printer by entering a "P", or just clear the screen and continue by pressing ENTER.

18. The user is then asked if he/she would like to replot the results (see Figure 7). "Y" will replot the data, "N" continues.

19. The user is asked whether he/she would like to plot a different concentration or dose contour (see Figure 7). If the user enters "Y", he/she is prompted to enter the new limit. If dose calculations were done (flag set in SECTION 8 of INPUT.DAT), the user can choose to either plot a new concentration or dose contour. If dose calculations were not done, the user is simply asked to enter the new concentration limit of interest. If "N" is entered, the program continues.

20. The user is asked whether he/she would like to plot the data with variable wind direction data considered (wind meander calculations) if the most recent plot did not have wind meander effects included. If the most recent plot did have wind effects included, the user is asked if he/she would like to replot the data WITHOUT wind meander effects. If the wind direction data file does not exist the program will not perform these calculations (read the next section to find out more about the wind direction data file).

Wind Direction Data File

The program can simulate the effects of variable wind direction occurring during a spill if the wind direction data is available. A data file is included on the diskette (WINDIR.DAT) which is a sample wind direction data file (see Table 4). The user can modify this file (using a text editor) to enter wind direction variation data of interest. The necessary data are: a) the clock time at which the wind direction data starts (Decimal 24 hour clock, 6:30 pm = 18.5), b) the constant time interval between wind direction data information, and c) the wind direction (in degrees, clockwise from North) at the next time interval. The clock time and time interval are on line 7 of the file and the wind direction data are on the remaining lines.

21. The user is asked whether he/she would like to plot the data at a different elapsed time since start of spill. If the use enters "Y", the current elapsed time is displayed (in minutes) and the user is asked to enter a new elapsed time.

22. The user is asked if he/she would like to save the output data. If the user enters a "Y", he/she is prompted to enter the names of the files in which the output data and the plot data should be stored.

23. Finally, the user is asked whether he/she would like to run another case (as shown in Figure 7). If a "Y" is entered, the program loops to Step 10 under Run the ADAM Program. If an "N" is entered, the program erases intermediate files created during the program execution, stores the results in a user named data file, and then terminates execution and returns to the DOS prompt.

E. Program Output

As stated above, both screen graphics output and file output are created by the ADAM program. The files can be saved as described above, in step 22. The two files saved are for regenerating contour plots and a summary of the program results. A brief description of the contents of these two files is indicated below. Other files may be resident in the directory if the program does not end successfully. These files will be erased the next time ADAM is run.

1. Program Results Summary File

This file contains a summary of the most recent program run. The first part is an exact copy of the INPUT.DAT file with the calculated source and atmospheric results appended to it. The next section of the file has 6 columns detailing the dispersion results, as shown in Table 3. These columns indicate: time since release, distance from source, cloud or plume velocity, peak centerline concentration, peak centerline dose (if calculated), contour semi width. This information can be used to more closely examine the behavior of the chemical after release.

2. Contour Plot Data File

This is a data file which when called by a program called REPLOT allows the user to regenerate contour plots. If the user wishes to save a contour plot for a later replotting, he/she must enter a name for the file as described in Step 20 (e.g., AMARUN#1.PLT). The plot can be recreated by running the REPLOT program with the following command:

REPLOT AMARUN#1.PLT

For additional information or for any clarification type of questions please call,

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TABLE 1: Directory Listing of Files Required to Run ADAM

```
README

ADAM       BAT
REPLOT     BAT

AMAPROP    DAT
CLXPROP    DAT
HDSPROP    DAT
NOXPROP    DAT
PHGPROP    DAT
SFDPROP    DAT

DEFAULT    DAT
INPUT      DAT

DEVICE     DAT
WINDIR     DAT

EGA        DEV

INI        EXE
OVER       EXE
SOURCE     EXE
DISPER     EXE
TSTDSPLT   EXE

EPSN       PRN

ED         EXE
RULER      DEF
RULER      PRT

    23 Files
```

TABLE 3: ADAM Program Results Summary File Listing

DISPERSION CALCULATION RESULTS

93 = # of Points
Contour for Concentration = 1.00 ppm

Time Since Release (s)	Distance From Source (m)	Velocity of Plume or Puff (m/s)	Peak Concentration (ppm)	Peak Dose (ppm-s)	Contour semi Width (m)
40.10	38.51	1.0022	3181.7	.0000	33.23
40.59	39.00	1.0029	3149.4	.0000	44.53
41.41	39.82	1.0042	3096.7	.0000	45.08
42.63	41.05	1.0063	3019.4	.0000	45.90
44.33	42.77	1.0093	2916.2	.0000	47.02
46.62	45.09	1.0135	2776.1	.0000	48.51
49.62	48.14	1.0193	2524.3	.0000	50.43
53.47	52.10	1.0277	2106.7	.0000	52.78
58.32	57.15	1.0395	1633.1	.0000	55.61
64.38	63.53	1.0559	1210.3	.0000	46.81
71.82	71.56	1.0784	870.57	.0000	67.67
80.86	81.58	1.1086	620.00	.0000	77.13
91.71	94.05	1.1486	434.83	.0000	85.13
101.4	113.4	1.9930	328.04	.0000	88.31
111.1	132.7	1.9930	261.90	.0000	92.40

TABLE 2: DEFAULT.DAT Input Data File for ADAM model

Air Force Dispersion Assessment Model (ADAM) Input Data

This file contains input data for running the ADAM model. The data is grouped into sections below. There are several simple rules that must be followed to avoid causing run-time errors:

You must use SCROLL LOCK to OVERWRITE data while editing this file.

Do not delete any fields/lines in this file.

Underline's (___) start at the RIGHT of the field in which numbers or characters are entered. The field size is set in the programs, and information entered in these areas, even if the underlines are moved, will not be used.

When entries are complete, save the information and the program will continue automatically.

SECTION 1: Release Information

---

your title _____Enter title of the Run

NOX_____Chemical Released (use code listed below)

AMA	ammonia
CLX	chlorine
HDS	hydrogen disulfide
NOX	nitrogen tetroxide
PHG	phosgene
SFD	sulfur dioxide

SECTION 2: Type of Release and Source Specifications

0_____Type of Release (0 Instantaneous/1 Continuous)
If instantaneous (0), fill in information for instantaneous releases below (SECTION 3).
If continuous (1), fill in the information for continuous releases (SECTION 4).

1_____Perform Source Calculations (1 Yes / 0 No)
If yes (1), fill in either SECTION 3 or 4, and SECTIONS 5-8.
If no (0), fill in the source information (SECTION 9) and SECTIONS 5-8. The information under SECTIONS 3 and 4 will be ignored.

SECTION 3: Instantaneous Release

33.0	(m3)	Volume of chemical in tank
2.5	(m)	Tank diameter
2.5	(m)	Tank height
293.0	(K)	Liquid storage temperature
1.0	(Atm)	Liquid storage pressure
0		Is there a dike? (1 Yes / 0 No)
20.0	(m)	Dike diameter
0.05		Fraction of the liquid left after flashing which is entrained as aerosols in the vapor

SECTION 4: Continuous Release

30.0	(m3)	Volume of chemical in tank
2.5	(m)	Tank diameter
2.5	(m)	Tank height
293.0	(K)	Liquid storage temperature
1.0	(Atm)	Liquid storage pressure
0.05	(m)	Hole size
0.0	(m)	Height of hole above ground level
0.05	(m)	Diameter of pipe
1.0	(Atm)	Liquid upstream pressure
0.0	(m)	Height of pipe above ground level
0.0	(m/s)	Flow speed in pipe
0		Is there a dike? (1 Yes / 0 No)
20.0	(m)	Dike diameter
0.05		Fraction of the liquid left after flashing which is entrained as aerosols in the vapor

SECTION 5: Ground Conditions

293.0	(K)	Ground Temperature
0.01	(m)	Ground Aerodynamic Roughness Length at Spill location
0.01	(m)	Ground Aerodynamic Roughness Length at the meteorological tower if different than at the spill location

Use the best description of the ground:

Smooth mud flats, Ice	Z0=0.00001
Calm sea/Snow covered flat ground	Z0=0.0001
Flat desert/Natural snow surface	Z0=0.001
Cut grass/Few trees (winter time)	Z0=0.01
Airport runways/Farmlands	Z0=0.1
Many trees/Hedges/Few buildings	Z0=0.3
Centers of large towns/Forests	Z0=1.0
Many tall buildings	Z0=3.0

SECTION 6: Atmospheric Conditions

```
293.0       ___( K )_______Air Temperature
 75.0       ___( % )_______Relative Humidity
  3.0       ___(m/s)_______Wind Speed
 10.0       ___( m )_______Height at which the wind speed is measured
180.0       ___(deg)_______Wind Direction, clockwise from North

0_____________________________Use wind statistical data for stability
                                 calculations? (1 Yes / 0 No)
-------IF Yes (1) fill in the next two fields
  0.0       ___(deg)_______Sigma theta
  0.0       ___(min)_______Wind averaging time
-------IF No (0) fill in the next five fields
  0.25      _______________Cloud Fraction
0_____________________________Snow covered ground (1 Yes / 0 No)
0_____________________________Wet ground (1 Yes / 0 No)
  0.26      _______________Cloud transmittance
                     Use the best description of the clouds:
                        Clear          = 1.00
                        High clouds    = 0.61
                        Medium clouds  = 0.26
                        Low clouds     = 0.17

--------Fill in the following fields to override atmosphere calculations
0_____________________________Override atmospheric calculations (1 Yes / 0 No)
  0.0       ___(m/s)_______Wind speed at 10 meters height (u10)
  0.0       ___(m/s)_______Wind friction velocity (u*)
  0.0       _______________Stability parameter
                        0.5  A  Extremely unstable conditions
                        1.5  B  Moderately unstable conditions
                        2.5  C  Slightly unstable conditions
                        3.5  D  Neutral conditions
                        4.5  E  Slightly stable conditions
                        5.5  F  Moderately stable conditions
```

SECTION 7: Time and Location Information

```
00_____________(01-31)_____Day  -- If day = 0, the computer clock date is read
00_____________(01-12)_____Month
00_____________(00-99)_____Year

_______To use the Computer clock time - set Current time to 00:00:00.00
00:00:00.00_(HH:MM:SS.SS)_Current Time (24 Hour Clock Midnight = 24:00:00.00)
00:00:00.00_(HH:MM:SS.SS)_Spill Time (Used to match dispersion data with wind
                                       meander data, if applicable)

 41.0       ___(deg)_______Latitude
 72.0       ___(deg)_______Longitude
```

SECTION 8: Output Specifications

0		Output dose information (1 Yes / 0 No)
100.0	(ppm)	Concentration contour of interest
10.0	(min)	Concentration averaging time
0.0	(ppm-s)	Dose contour of interest
0		Do you want variable wind direction effects shown? (1 Yes / 0 No). If yes, the file 'WINDIR.DAT' must exist.

SECTION 9: Source Specifications

Fill in this section if you have set the flag to bypass source calculations in SECTION 2, above.

0		Type of source release (0=Inst, 1=Cont)
.000	(kg or kg/s)	Mass (or mass rate) of chemical released
.000	(K)	Chemical vapor temperature upon release
.000		Fraction of the chemical released which is entrained as aerosols in the vapor.
.000	(kg or kg/s)	Mass (or mass rate) of air entrained initially during release.
.000	(m)	Width of the released cloud or plume
.000	(m)	Height of the released cloud or plume
.000	(J or J/s)	Heat (or heat rate) input to source air and chemical
.000	(m)	Source length (e.g., jet length, pool radius)
.000	(m/s)	Initial cloud or plume velocity

END OF FILE

When entries are complete, save the information and the program will continue automatically.

TABLE 4

WIND DIRECTION DATA FILE FORMAT (WINDIR.DAT)

```
The first six lines of this data file are for comments.
List the starting time, time increment, number of data points and data
below in the appropriate lines, keeping all numbers in the first 10 columns.
Up to 100 data points (enough for every 15 mins for 24 hours) can be
entered.
---------1-:-------2:-------------------------------------------------
  18.0          5.0 :Wind data starting time, del time, 24 hr clock, mins
000.00      :Wind direction at starting time, in degrees, 0 deg = from North
000.00      :                                              90 deg = from East
000.00      :                                             180 deg = from South
000.00      :                                             270 deg = from West
045.00
045.00
045.00
045.00
090.00
090.00
090.00
090.00
135.00
135.00
135.00
135.00
180.00
180.00
180.00
180.00
225.00
225.00
225.00
225.00
270.00
270.00
270.00
270.00
315.00
315.00
315.00
315.00
000.00
000.00
000.00
000.00
```

A D A M

Air Force Dispersion Assessment Model

This program models the dispersion of chemicals released into the atmosphere.

The models request the user to input the details of the release conditions. Using the input data, a source strength is calculated and the results are plotted to the screen and written to files. The models used include:

- o Source models for over 16 different release types
  (Two-phase Jet release, Liquid release, Gas Release, etc.)
- o Thermodynamic models for chemical reactions and interactions
  (Chemical reactions, Aerosol effects, Heats of mixing, etc.)
- o Heavy Gas models for describing the initial slumping of the puff or plume

Details of the model are contained in a Technical Report to the USAF.

PRESS <ENTER> TO CONTINUE

FIGURE 1: ADAM General Information Screen

A D A M

Enter I, D, or U to choose input data file to use:

Enter I to use INPUT.DAT.

Enter D to overwrite INPUT.DAT with DEFAULT.DAT

Enter U to input the name of the input data file to use

(Entering D or U will destroy the current INPUT.DAT file.)

FIGURE 2: ADAM Input Data File Choice Menu

```
Press Esc for no backup, F1 to make backup copy "INPUT.&DA"

* * PC-Write (tm) Version 2.55. Released on 30-Jun-85. Registration #000001 * *
*   (C) Copyright 1983,1985 by Bob Wallace, Quicksoft. All Rights Reserved.   *
*                                                                             *
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*   You can order materials and services separately, with the prices above.   *
*   Registration without commissions is $70.  Quantity discounts available.   *
*   PO, COD, Rush, add $5.  WA orders add 7.9%.  Foreign orders, send $U.S.   *
*                                                                             *
* * Quicksoft (tm), (206) 282-0452.  219 First N. #224, Seattle, WA  98109. * *

F1 Help. CapPtJustOff. 82% Free.  0% Thru. Read "INPUT.DAT"
```

FIGURE 3: PC-Write Initial Screen

```
                                    A D A M




READING AND CHECKING INPUTS
```

FIGURE 4: ADAM Status Screen

```
                              A D A M

   CHEMICAL:  NITROGEN TETROXIDE

---------------- DATA CALCULATED (OR READ IN) BY SOURCE MODELS ----------------
Mass of Chemical In Vapor Cloud.............................:  2000.000 kg
Chemical Temperature Upon Release...........................:   294.000 K
Mass of Air Initially Entrained by the Cloud................:  4000.000 kg
Cloud Radius at End of Source Calculations..................:    41.600 m
Heat Input to Cloud in Source Calculations..................:      .000 J
Fraction of the Liquid After Flash Which is Entrained.......:      .000
Liquid Aerosol Mass Fraction in the Initial Undiluted Cloud..:      .000

------------- DATA CALCULATED (OR READ IN) BY ATMOSPHERIC MODELS -------------
Continuous Stability Parameter..............................:     4.400
Wind Friction Velocity (U*).................................:      .200 m/s


    Do you wish to store the above (calculated) data for source strength
       in SECTION 9 of the INPUT.DAT file? (Y,N)  n

    Do you wish to revise input data before dispersion calculations
       are made (Y,N)? (Yes will retun you to edit input data.)
```

FIGURE 5: ADAM Source Calculation Summary Screen

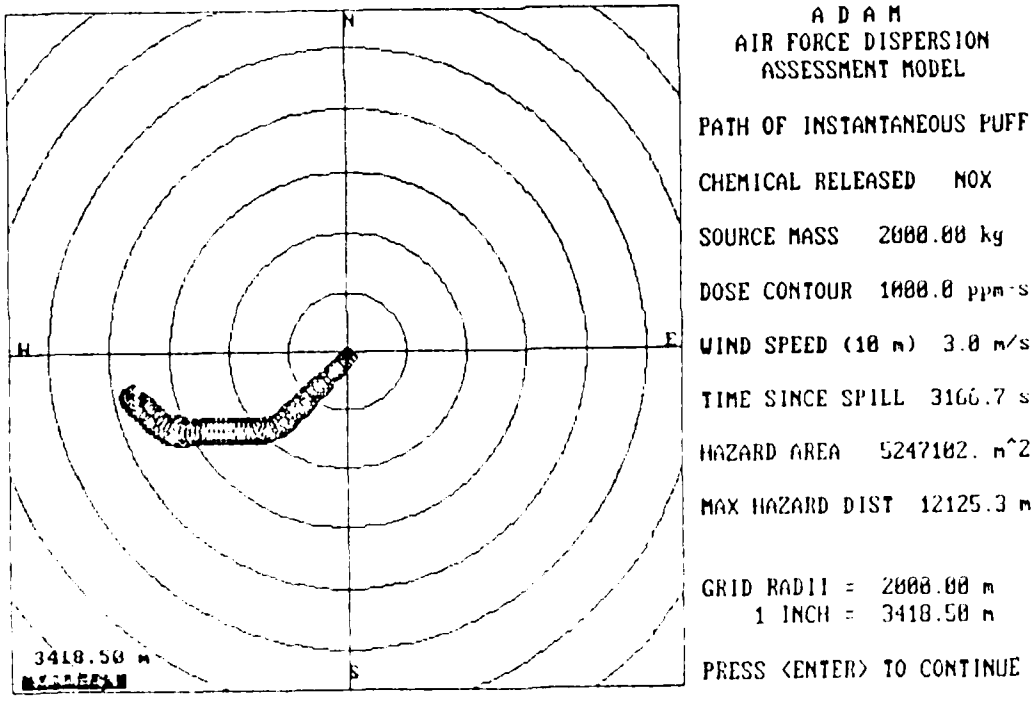

FIGURE 6: ADAM Graphics Screen Output

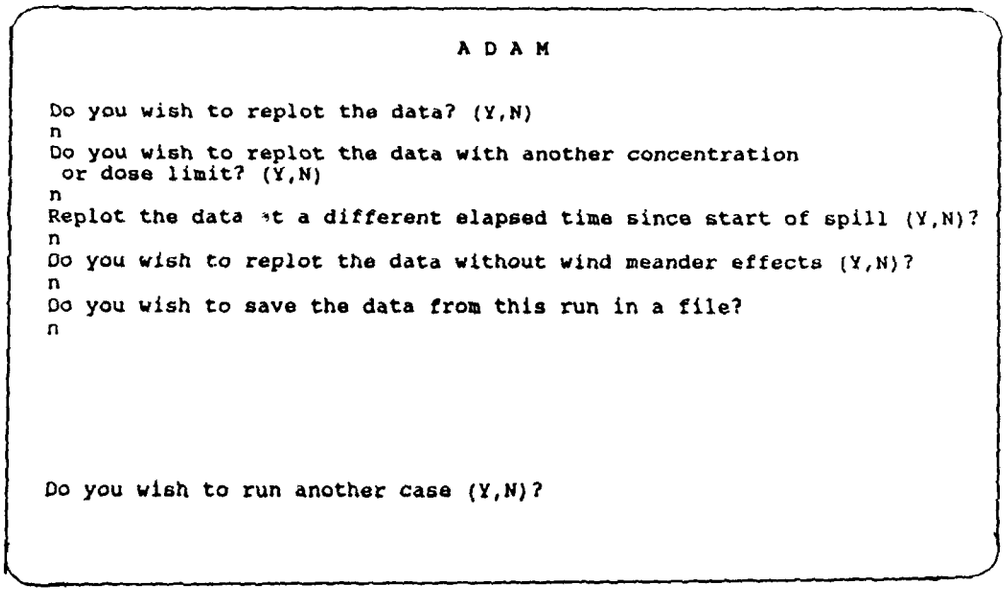

FIGURE 7: ADAM Dispersion Calculation Menu Screen